EDITORIAL.

In the American chapter of the third edition of Dr. Geikie's *Great Ice Age*, formational names were proposed for three of the better known till sheets of the glacial series. It was not without some hesitation that this was done because it was not wholly clear that the time was ripe for nomenclature, but the helpfulness of specific names and the superiority of stratigraphic terms over the time-phrases, period, epoch and episode, of controverted application, seemed to overbalance the infelicities that would arise from the immature state of investigation. It was anticipated that further study would give occasion for additions and emendations. The ready and general acceptance of the names seems to have justified their proposal; indeed, other workers in the glacial field have felt that the method might, even at once, be extended to other divisions less well elaborated. To the names Kansan, Iowan and Wisconsin, which were suggested for the three best known till sheets (Toronto being applied to an interglacial fossiliferous deposit, and Aftonian being subsequently added) Dr. George M. Dawson has proposed to add the term Albertan to designate a series older than the Kansan, and Mr. Upham has proposed the addition of Warren, Iroquois and St. Lawrence to designate later till sheets. Previous to these additions Dr. Geikie had proposed a full series of similar names for the European glacial deposits.

The studies of the past two years seem to show that within the limits of the series covered by the three names first proposed, there is, probably, need for some extension and revision. This arises chiefly from the progress made by the geologists of the Iowa Survey, Messrs. Calvin, Bain, Norton and Beyer, and by my colleague, Mr. Leverett. It will be recalled that in eastern Iowa

the elaborate investigations of Mr. McGee some years ago demonstrated the existence of two sheets of till, separated by a vegetal horizon. It was known that in southern Iowa there were also two sheets of till separated by a vegetal horizon, but these had not been studied in detail nor their connections traced out. It was natural, as well as prudentially conservative, to suppose that these two series were mutual equivalents, as they stood in much the same geographic relationship to the later (Wisconsin) drift. It was recognized that the amount of erosion upon the south Iowan series was greater than that upon the east Iowan, and also that the loess in eastern Iowa was intimately connected with the upper till sheet, while the upper till sheet in southern Iowa was separated from the loess by a definite interval, but the importance of these differences was not fully appreciated. The investigations of the Iowa geologists have led to the quite firm conviction that the upper till sheet of the series in southern Iowa is the lower member in eastern Iowa. They have also become convinced that the upper sheet in southern Iowa extends continuously across northwestern Missouri into Kansas, and is the equivalent of the drift sheet that covers the northeastern part of Kansas. State Geologist Keyes of Missouri concurs in this view. They do not hold this to the exclusion of a possible lower member in Kansas. In harmony with these views the upper till in the southern part of Iowa has been designated Kansan in the recent Iowa reports.

During the past summer I have had the pleasure of making two excursions with Mr. Bain of the Iowa survey to localities where the above formations are advantageously exhibited, and I have been impressed with the cogency of the arguments of the Iowa geologists. While, therefore, the case cannot be said to be demonstrative, as yet, it seems best to accept the application of the nomenclature adopted by the Iowa survey. This places the Aftonian beds below the Kansan series instead of above them. It puts the sub-Aftonian sheet of till in an earlier category, and, for the present, it may perhaps be regarded tentatively as Albertan, although, of course, it cannot now be

demonstrated to be equivalent to the Albertan beds of Canada. The studies of Mr. Leverett have made it quite sure that the Kansan ice-sheet crossed the Mississippi and invaded Illinois to some moderate distance. He has also shown that the Illinois ice-sheet returned the compliment and invaded Iowa. Between these invasions there was a considerable interval of time, as indicated by the greater erosion of the Kansan deposits and by the prevalence of a soil horizon and of peat beds between the Kansan and Illinois till sheets where they overlap. He has shown also that there was a notable interval between the invasion of Iowa by the Illinois ice-sheet and the spreading of the loess over its deposits, as indicated by erosion and the formation of a soil horizon. This loess mantle seems to be identical with that which is intimately connected with the east Iowan drift sheet. It thus appears that the invasion of the Illinois ice marks a distinguishable stage of glaciation separated by a notable interval from both the earlier Kansan stage and the later Iowan stage. This interval appears to be of such moment as to make it inadvisable to correlate the Illinois drift sheet with the Iowan drift sheet. As a result, the practice of designating the former the Illinois sheet has already sprung up among us. The evidence at present seems sufficient to justify its tentative use in the literature of the subject. It should of course be credited to Mr. Leverett.

The series in the Mississippi basin, as thus modified, would be as follows in stratigraphic order:

9. Wisconsin Till Sheets (earlier and later).
   8. Interglacial deposits (Toronto perhaps).
7. Iowan Till Sheet.
   6. Interglacial deposit.
5. Illinois Till Sheet (Leverett).
   4. Interglacial deposit (Buchanan of Calvin).
3. Kansan Till Sheet.
   2. Aftonian beds, Interglacial.
1. Albertan Drift Sheet (Dawson).

The completion of the nomenclature by the naming of the interglacial deposits is desirable, but it is doubtful whether it can be satisfactorily done at present. The correlation of the Toronto beds with the Mississippi series seems to me to remain uncertain, but they are so preëminently fitted to give name to their horizon that it seems best to reserve for them the place to which they most probably belong. Some of the known vegetal deposits found below the Iowan till sheet could appropriately give name to the interglacial deposits between the Iowa and Illinois beds if their horizon could be positively fixed, but it cannot now be stated certainly whether the interval marked by these is that between the Iowan and Illinois sheets, or that between the Illinois and Kansan sheets. The Buchanan gravels are regarded by Professor Calvin as marking the initial stages of the interval following the formation of the Kansan drift, and the term Buchanan has been employed by him in designating this interval. The probable close connection between the formation of these gravels and the underlying drift renders the name something less than ideal as the designation of true interglacial deposition, but the pronounced characteristics of the formation and its great significance, joined to its excellent exposure and easy accessibility, make it doubtless the best nominative deposit now available.

While returning from my last visit to the field in which the Kansan, Illinoian, Iowan, and Wisconsin formations were seen in close succession, I made a memorandum of impressions respecting their relative ages simply as a means of comparison with judgments formed at other times, the impressions being derived from the respective degrees of erosion and chemical change which the formations have undergone. Although this was intended to be nothing more than a record of passing impressions, it may be the best means of giving some notion of my rating of the historical importance of the formations. Taking the interval from the late Wisconsin deposits (as found immediately south of the Great Lakes) to the present date as unity, the following is the memorandum:

From the close of the later Wisconsin to the present,	1 unit
From the earliest Wisconsin (Shelbyville moraine) to the present,	2½ units
From the Iowan to the present,	5 "
From the Illinois invasion of Iowa to the present,	8 "
From the Kansan to the present,	15 "
From the sub-Aftonian (Albertan) to the present,	x "

Four of the investigators previously named who have seen this memorandum are disposed to increase the figure for the Kansan, and some of them would alter other figures in the same direction, with perhaps a reduction of the estimate for the Iowan. After the estimate had been made it was observed that the intervals form a symmetrical diminishing series. The temperature variations of the period might therefore be represented by an oscillating curve with declining waves.

T. C. C.